UTILIZATION OF BANANA TRUNK ASH AND COCONUT SHELL ASH AS PARTAL REPLACEMENT OF CEMENT IN MORTAR

K.S. Shobana[1], J. Jayachandharan[2], T. Kaviyarasu[3], J. Kishore[4]

[1]Assistant professor, Department of Civil Engineering, Dr. N. G. P. Institute of Technology, Coimbatore

[2, 3, 4]UG Students, Department of Civil Engineering, Dr. N. G. P. Institute of Technology, Coimbatore

Abstract

Nowadays, construction industry had grown up to become as one of the important industry in India. One of the important components in construction industry is mortar, which act as a binder to give strength and to hold bricks with different size and also to patch work in the wall of the building. As stated, this research is done to determine the best portion of banana trunk ash and coconut shell ash to replace the cement in the making of mortar and also to determine the strength of mortar. Both banana trunk ash and coconut shell ash is an agriculture waste that has potential to replace one of the construction material which is cement. Banana trunk ash and coconut shell ash contains a pozzolanic reaction that usually occurs in Portland cement.

The ash was produced from the process of burning the dried banana trunk and the coconut shell into the furnace at 500°C for 2 hours. In this research, compression test was conducted to determine the compressive strength of the mortars that replace the cement with 5%, 10% and 15% weight of banana trunk ash. A total of 9 specimens with size of 70mm x 70mm x 70mm were prepared by using mould. All the specimens had been tested after 7 days, 14days and 28 days of curing. Based on the test results percentage of the banana ash is fixed. Similarly, the process is carried out for the coconut ash also. The combination of both ash in mortar gives the new construction material.

Key words: Coconut shell ash, Banana trunk ash, Pozzolanic property.

I. INTRODUCTION

The demand of cement for construction is very high and cause maximum production of the material in India. In high production of cement high amount of carbon dioxide will emitted in environment. So alternate material for cement is essential to reduce the pollution in environment. Cement is material with adhesive and cohesive properties and its function is to bind fine and coarse aggregate together.

Cement also act as filler to any void in development in construction material is being increased by time. There are many researches about utilization of agriculture waste to substitute the material in construction. The waste product such sugarcane, banana trunk ash, coconut shell ash, eggshell and others waste product can probability to replace the cement, fine aggregate and coarse aggregate.

Banana trunk ash & coconut shell ash are the example of agriculture waste. Banana trunk ash (BTA) & coconut shell ash are used as pozzolanic material in civil structures with advantages such as lower costs and the equivalent reduction of environmental impacts resulting

from the accumulations of this type of residue in the field. The cement mortar dosage with 5 %, 10% and 15% BTA & coconut shell ash are manufactured and tested.

In this research, banana trunk ash & coconut shell ash are used for replacement for cement. These are used as cementitious material to produce high strength of mortar. The composition of the banana trunks ash & coconut shell ash have good characteristic to be use as binder in the mortar.

II. LITERATURE REVIEW

Utsev. J.K et.al.,(2012),“ Coconut shell ash as partial replacement of ordinary Portland cement in concrete production”- Stated that the coconut shell it is sundried for 48 hours for removing moisture content present in it. After sundried it is burning in open air in uncontrolled combustion for 3 hours, allowed for cooling for 48 hours, and burnt ash is obtained. The ash is collected and sieved by 75micron sieve and collected. Ash contains of 37.97 % SiO_2,24.12% Al_2O_3, 15.48% Fe_2O_3,4.98% CaO,1.89% MgO,0.81% MnO,0.95% Na_2O_3,0.83% K_2O,0.32% P_2O_5,0.71% SO_3 and 11.94 % LOI. They are replacing 0,10,15,20,25, and 30% for the mix design of 1:2:4. In this experimental study the replacement of 10-15% replacement of ash attains more strength compare to other ratios.10% of replacement of ash give strength nearly equal to conventional concrete. The 0% replacement the strength of cube at 28 days is 34.22 N/mm^2 and 10% of replacement the strength of cube is 31.78 N/mm^2

Swaminathan et.al., (2018),“ Stabilization of black cotton soil by using coconut shell ash, iron powder and lime” - Said that the treatment of black cotton soil is necessity because of high swelling and shrinkage property. To improve the bearing capacity of soil to stabilization the soil reinforcement using iron powder, coconut shell ash, lime. The lime consists of 4.02% of silica, 5.64% of insoluble matter, 1.92% of ferric oxide, 1.36% of alumina, 59.42% of calcium, 0.92% magnesia,26.72% of loss of ignition. To introduce the iron powder, coconut shell ash, lime in the combination of all in 0%,3%,6%,9%,12%. The optimum content content was obtained for 12% coconut shell ash,9% of lime,9% of iron powder. The CBR test result was obtained 12% with addition of coconut shell ash, iron powder, lime.

B..N.V.D.S.Prakash et.al.,(2018),“ Experimental study on partial replacement of cement with coconut shell ash and egg shell powder” - Stated that the use of waste materials with pozzolanic properties in concrete production is becoming a worldwide practice .In this literature review the coconut shell ash and egg shell powder of 0%,5%,10%,15%,20%,25% of replacement for M40 grade of concrete. The 15% cost will be reduced in this use of coconut shell ash and egg shell ash replaced by cement. The above experimental study results the 15% of replacement of egg shell powder and coconut shell obtain high strength. The compressive strength and split tensile strength of 15% replacement is achieved at 28 days is 48.93N/mm^2 and 2.44N/mm^2.

Rajendra Kumar Goyal et.al.,(2016),“ Use of banana leaves ash in concrete” - Mentioned that the banana leaves ash is replaced by cement in concrete up to 30% at an interval of 10%. The grade of concrete M40 is used. Banana trunk is cut layer by layer and bum in

heater. Banana leaves ash is replaced by cement in concrete up to 30% at an interval of 10% and then properties of concrete like compressive is checked after 7, 14 and 28 days curing. The optimum value for banana leave ash is 20%. Initially up to 20% when banana leaves ash is added in concrete it increases compressive strength then compressive strength of the concrete is decreased in 30% replacement mix of concrete. 20% replacement of cement by supplementary cementitious material made with waste banana leaves ash expands the compressive quality of cement by around 20-30% at 28 days. Banana leaves ash utilized solid takes 14 days to build up the objective mean quality and following 14 days the quality improvement is more than that of the control example. Banana leaves ash displays pozzolonic property and it is likewise joining in hydration process.

Aswathy.U et,al.,(2018),“ Experimental Studies of Coconut Shell Ash Composites in Concrete”. In this study the effect of coconut shell and its ash has been investigated and the experiments have been done to utilize these waste materials with concrete as a partial replacement for coarse aggregate and cement. The grade of concrete used is M25. The aim of this research is to address the issues related to shortage of conventional material, problem of disposal of waste material and review the work done on the use of waste coconut shell ash for the production of concrete, and to spread awareness about the utilization of coconut shell ash as a construction material in civil engineering. In This experimental study obtain the Compressive strength of concrete is increased by almost 18% by partial replacement of sand with 30% of Coconut Shell Ash in concrete. The Split tensile strength of concrete is increased by almost 28% by partial replacement of sand with 30% of Coconut Shell Ash in concrete.

Biju Mathew et.al.,(2016), “ An experimental study on properties of cement mortar by replacement of natural sand with manufactured sand”. This paper reports the experimental study of effect of replacement of natural sand by manufactured sand on properties of cement mortar with mix of 1:2, 1:6 and 1:3. Conventional Cement mortar was prepared by using river sand for different cement mortar ratios and replacing the natural sand by M-sand for the levels of 20, 40, 60, 80 and 100%. Mortar cubes of size 70.7x70.7x70.7 mm were casted, cured at room temperature and tested for compressive strength after 3 days, 7 days, and 28 days. Strength and durability characteristics of cement mortar using natural sand, M-sand as fine aggregate at various replacement levels were evaluated and compared. The compressive strength with 60% replacement of natural sand by manufactured sand reveals higher strength as compared to reference mix in 1:2 ratio mortar 3. The compressive with 80% replacement of natural sand by manufactured sand reveals higher strength as compared to reference mix in 1:3 and 1:6 ratio mortar. For 1:3 cement mortar prisms, higher strength found to be at 60 % M sand replacement and.40 % m sand replacement gives the higher strength for 1:6 cement mortars. 6. By referring all these results, it was found that 40 - 60 % replacement of m sand shows the higher compressive strength.

Aman S, et.al.,(2018), “ Experimental Investigation on Properties of Concrete by Partial Replacement of Cement with Banana Leaves Ash”. This study was under taken to know the concrete properties using Banana Leaves ash. The banana trunks ash was produced from the process of burning the dried banana trunk and collecting the residue of it. The BLA will be used in cement to replace about 0%, 15%& 25% respectively. Mechanical properties such as

compressive, split tensile and flexural strength were determined by casting cubes, cylinders and beam respectively. As the percentage of BLA increases in the concrete the compressive strength attends the desired strength at 28 days for 15 % replacement with cement & decreases for 25 % replacement. The Flexural & Split Tensile strength increases for 15% replacement & slightly decrease for 25 % respectively as compare to normal mix. From the above graphs we can conclude that the Compressive, Flexural & Split tensile strength increases at 15 % replacement of cement with BLA. The optimum percentage of cement for partial replacement with BLA is 15 %.

M.Vigneshkumar et.al.,(2018), " Experimental Study on Partial Replacement of Cement with Coconut Shell Ash and Silica Fume in Concrete". This study reveals that the strength performance of concrete using Ordinary Portland Cement and Coconut Shell Ash and Silica Fume. Initially, coconut shell ash and silica fume samples were collected and its properties were investigated. Normal consistency and setting time of the pastes containing ordinary Portland cement and coconut shell ash at 5%, 10% & 15% and silica fume at 5% & 10% replacement were investigated. Compressive strength, flexural strength, split tensile strength, durability test and density of M50 concrete containing ordinary Portland cement with coconut shell ash at 5%, 10% & 15% and silica fume at 5% & 10% replacements were also investigated at water cement ratio 0.35. It is observed that compressive strength, split tensile strength and flexural strength are on higher side for 15% of CSA & 10% SF as compared to other concrete mixes. The optimum value for (CSA + SF) in cement concrete was found to be (10% + 10%).

S. Aruna Devi et.al.,(2014), " Experimental Study on Partial Replacement of Cement with Coconut Shell Ash in Concrete" - Said that the agricultural waste material, in this case, coconut shells, which is an environmental pollutant, are collected and burnt in the open air (uncontrolled combustion) for three hours and that product is incinerated in muffle furnace at 800oC for 6 hrs to produce coconut shell ash (CSA), which in turn was used as pozzolana in partial replacement of cement in concrete production. Concrete mortar cubes were produced using replacement levels of 0 and 5 percent of OPC with CSA. The Coconut Shell ash is used for the partial replacement of cement. Further, use of coconut shell ash as a value added material as in the case of binary blended cement concrete, reduces the consumption of cement. The setting times increases with increase in the amount of coconut shell ash. The initial setting time increases from 1 hour 5 minutes at 0% replacement to 3 hours 26 minutes at 30% replacement while the final setting time increases from 1 hour 26 minutes at 0% replacement to 4 hours 22 minutes at 30% replacement. The 7 days strength decreases from 13.78N/mm2 for OPC to 6.43N/mm2 for 30% replacement with CSA. The strength after 28 days curing decreases from 34.22N/mm2 for OPC to 13.11 N/mm2 30% replacement with CSA. The optimal 28 days strength for OPC-CSA mix is recorded at 10% replacement (31. 78N/mm2).

Appukutty P et.al.,(2009), " Substitution of Quarry Dust to Sand for Mortar in Brick Masonry Works" - The author studied that the substitution of crusher dust for sand in cement mortar for brick masonry is experimented with brick masonry prisms cast in 22 different ratios of 1:8, 1:6, 1:5 and 1:4. Bricks with basic compressive strength above 3.5 N/mm^2 and 7.5 N/mm^2 were used to cast brick masonry prisms. Three types of fine aggregates, i.e. Cauvery

river sand, Crusher dust as is available form stone crusher sand crushers which fines below150 microns removed were used for mortar. Three samples of brick masonry prisms in each mortar ratio were built, cured for 28day sand tested for the basic compressive strength. Theresultsof12prisms tested in each fine aggregate with different mortar ratios are compared with allowable compressive strength requirements of brick masonry specified by IS 1905-1989. The performance of the fines removed crusher dust in cement mortar for brickwork is better than sand and crusher dust in strength. There is cost reduction of about 12.50% in brick work and 20.80% in stone masonry by replacing the sand.

Mir Abdul Kuddus et.al.,(2016), "Investigation of Mechanical Behaviour of Concrete by Replacing Cement with Coconut Shell Ash & Stone Dust" – Reported that the possible use of coconut shell ash (CSA) and stone dust (SD) as partial replacement of ordinary Portland cement (OPC). Several cylinders were cast, cured and crushed at 3, 7, 28 and 90 days for uniaxial compression test (UCS) and 3, 7 & 28 days for static elastic modulus test (SEM). Concrete beams were crushed at 3, 7, 28 days for flexural strength test (FS). Drying shrinkage test (DS) also performed by using mortar beams. The coconut shell ash was replaced from 0 to 30 percent at 10% intervals. It was observed that the compressive strength increased by 7.50% when cement was replaced by 10% of CSA & SD. On the other hand, static elastic modulus and flexural strength were increased by 44% and 3.50% for the same mix proportions (10%). Also, drying shrinkage decreased by 53% when cement was replaced by 10% of CSA & SD. The uniaxial compressive strength shows an increase in strength by 7.50% for 10% replacement of OPC by coconut shell ash (CSA) and stone dust (SD). The static elastic modulus test shows an increase in modulus of elasticity by 44% for 10% replacement of Ordinary Portland cement (OPC) by CSA and SD. The flexural strength test shows an increase in strength by 3.50% for 10% replacement of OPC by CSA and SD.The drying shrinkage test shows a decrease in 53% for 10% replacement of OPC by CSA and SD.

III. CONCLUSION

The coconut shell ash and banana trunk ash are to be effectively used as a partial replacement of cement. So reduce the cement consumption is very less so the carbon dioxide emission is reduced in the environment. coconut shell ash and banana trunk ash having good pozzolanic property it will improve the strength of cement mortar and concrete and also gives high workability to concrete.

There is a major challenge to search for a material that is readily available at low cost which is environment friendly and can be used totally or partially to replace cement in mortar and concrete production. Reduction of cement consumption will reduce the emission of co_2 to the environment. This will reduce the pollution in the environment.

Agricultural wastes such as banana trunk and coconut shell has been disposed wastely to the environment. Since there is pozzolanic property in these waste materials, it can be used for the partial replacement of cement.

The issues related to shortage of conventional material, problem of disposal of waste material and review the work done on the use of waste banana trunk ash and coconut shell ash

for the production of concrete, and to spread awareness about the utilization of banana trunk ash coconut shell ash as a construction material in civil engineering can be made in the research.

REFERENCES

1. Anuragi.P, Dr. Benny Joseph, Biju Mathew and Dr Freeda Christy C (2016) 'An Experimental Study on Properties of Cement Mortar by Replacement of Natural Sand with Manufactured Sand', International Journal of Civil Engineering and Technology (IJCIET), Vol.7, pp.483–490.
2. Abhishek Tiwari and Rajendra Kumar Goyal (2016) 'Use of Banana Leaves Ash in Concrete' International Journal for Scientific Research & Development, Vol.4, pp.1696-1697.
3. B.N.V.D.S. Prakash, B. Satyanarayana & Ch. Veerottam Kumar (2018) 'Experimental Study on Partial Replacement of Cement with Coconut Shell Ash and Egg Shell Powder' International Journal for Scientific Research & Reviews, Vol.7(3), pp.48-56.
4. Taku, J. K and Utsev, J. T (2018) 'Coconut Shell Ash as Partial Replacement of Ordinary Portland Cement in Concrete Production' International Journal for Scientific & Technology Research, Vol.1, pp.86-89.
5. Bevin salo, Dinesh kumar, Jothiswar, Krishnamoorthi and Swaminathan (2018) 'Stabilization of Black Cotton Soil by Using Coconut Shell Ash, Iron Powder and Lime' International Journal for Scientific Research & Reviews, Vol.7, pp.193-201.
6. Aswathy.U and Dr. I. Padmanaban (2018) 'Experimental Studies of Coconut Shell Ash Composites in Concrete' International Journal of Latest Engineering and Management Research (IJLEMR), Vol.03, pp.22-25.
7. Aman S, Jugal R, Khaire and Pawar (2018) 'Experimental Investigation on Properties of Concrete by Partial Replacement of Cement with Banana Leaves Ash' International Journal for Research in Engineering Application & Management (IJREAM), pp.789-794.
8. M.Vigneshkumar, and Dr.R.Umamaheswari (2018) 'Experimental Study on Partial Replacement of Cement With Coconut Shell Ash And Silica Fume In Concrete' International Research Journal of Engineering and Technology (IRJET), Vol.05, pp.2175-2179.
9. S. Aruna Devi, S. P. Manohari, M. Maria Santha and Vignesh Kumar Nagarajan (2014) 'Experimental Study on Partial Replacement of Cement with Coconut Shell Ash in Concrete' International Journal of Science and Research (IJSR), Vol.03, pp.651-661.
10. Appukutty P and Murugesan R (2019) 'Substitution of Quarry Dust to Sand for Mortar in Brick Masonry Works' International Journal on Design and Manufacturing Technologies, Vol.3, No.1, pp.59-63.
11. Mir Abdul Kuddus, Abid Hasan Manon, Md. Midul Hossain and Shoaib Ibn Hasan (2016) 'Investigation of Mechanical Behaviour of Concrete by Replacing Cement with Coconut Shell Ash & Stone Dust' International Conference on Civil Engineering for Sustainable Development, Vol.3, pp.828-835.